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(71) AMERICAN STANDARD INC.,,
One Centinnial Avenue, PISCATAWAY, XX (US).

(72) BRIDEGUM, James E. (US).

(74) Ridout & Maybee

(54) CHAUFFE-EAU ALIMENTE AU GAZ, A CHAMBRE DE COMBUSTION AMELIOREE
(54) COMPACT GAS FIRED WATER HEATER WITH IMPROVED COMBUSTION CHAMBER

(57)

A compact gas fired water heater is provided for recreational vehicles and other side wall installations, wherein the water heater is designed to have minimum width and height dimensions and at the same time have more internal heating surface for greater recovery and higher efficiency than water heaters of similar dimensions. The combustion chamber is comprised of two straight horizontal lengths of tube joined in the rear by a specially formed coupler which enables the bottom inlet and the top outlet of the tube to make a smaller radius turn than that permitted with a bent tube type combustion chamber.

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(72) BRIDEGUM, James E., US
(71) AMERICAN STANDARD INC., US

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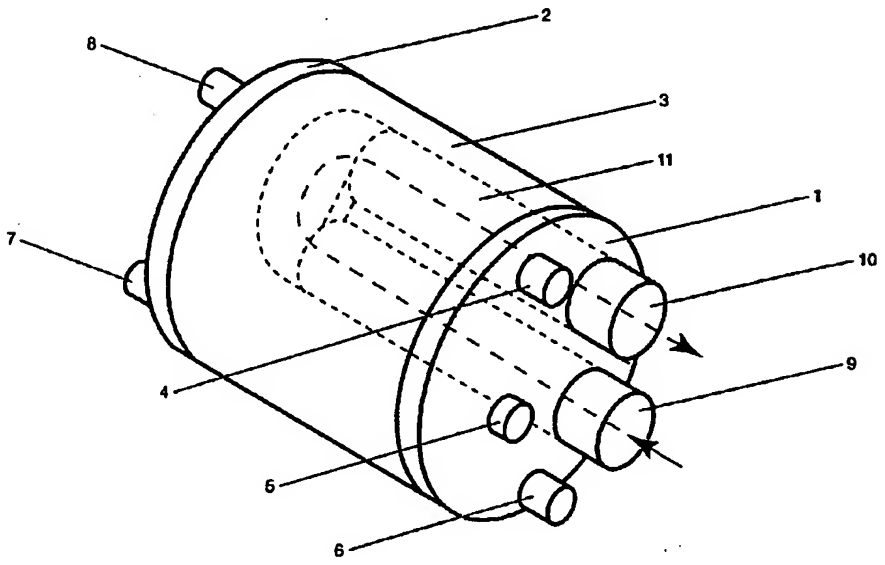
(54) **COMPACT GAS FIRED WATER HEATER WITH IMPROVED COMBUSTION CHAMBER**



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COMPACT GAS FIRED WATER HEATER WITH IMPROVED COMBUSTION CHAMBER

ABSTRACT OF DISCLOSURE

A compact gas fired water heater is provided for recreational vehicles and other side wall installations, wherein the water heater is designed to have minimum width and height dimensions and at the same time have more internal heating surface for greater recovery and higher efficiency than water heaters of similar dimensions. The combustion chamber is comprised of two straight horizontal lengths of tube joined in the rear by a specially formed coupler which enables the bottom inlet and the top outlet of the tube to make a smaller radius turn than that permitted with a bent tube type combustion chamber.

COMPACT GAS FIRED WATER HEATER WITH IMPROVED COMBUSTION CHAMBER

BACKGROUND OF THE INVENTION

This invention relates generally to an improved compact gas fired water heater for installation in recreational vehicles. Specifically this invention relates to a gas fired water heater of compact size with an improved combustion chamber that offers manufacturing, dimensional, cost and performance advantages over water heaters of this type currently available for such installations.

While combustion chambers of various designs and configurations have been invented and used for furnace and other space heating applications, the methods employed over the years for combustion chambers for water heaters for the recreational vehicle market has been limited to gas fired direct vent type designs to meet rigid space limitations, test pressure requirements mandated by various regulatory codes, and design methods that will offer the most economical products to the recreational vehicle manufacturer and the consumer. Consequently water heaters for recreational vehicles continue to be made with direct vent type combustion chambers utilizing either bent tubes first revealed in the Hammersley and Carlson patents, where the inlet and outlet ends of a tube are both positioned in the front side of a water heater, or a larger diameter straight horizontal tube first suggested in the Wariner patent, closed at the rear, wherein a burner can be positioned in the front lower half of the tube below a median divider plate with

an opening in the rear, so that hot gases will circulate from the front to the back of the tube and then exit on the front side in the upper half of the horizontally positioned tube.

With the bent tube type combustion chambers utilized in many recreational vehicle water heater tanks today, hot gases are injected into the tube by a burner placed at the entrance of a tube in the lower portion of the front of the water heater. Hot gases then circulate through the tube and exit the tube in the upper portion of the same front side. Since both ends of the tube, the entrance and exit, are positioned in front of the water heater, the fronts of such water heaters must be large enough to accommodate the "U" shaped bend in the tube between the entrance and the exit. Due to the large radius required to make the "U" shaped bend without distorting the tube, the dimensions of such water heaters must be either wider or higher than a water heater employing the single straight tube type construction. Consequently water heaters utilizing bent "U" tubes will often not fit into the openings or cut out sizes desired by many of the recreational vehicle manufacturers for the installation of water heaters, and they cannot be used in the after market as replacements for water heaters employing straight tube type combustion chambers that have been installed in recreational vehicle side walls with smaller cut out dimensions.

While water heaters with single horizontal tube type combustion chambers that have been used for years have smaller

width or height dimensions in front of the water heaters than water heaters made with bent tube type combustion chambers, and thereby fit into the smaller openings which are desired by the recreational vehicle manufacturers, they have certain disadvantages. With this method of construction, a burner positioned in the lower portion of the tube, discharges the products of combustion through the lower portion of the horizontal tube below an integral median divider that extends approximately four fifths of the way from the front to the back of the tube. The gases make a turn in the rear of the tube as they make contact with the rear closure plate, and then move upward and exit through the top portion to the tube above the entrance. One skilled in the art, can readily observe that this construction, while permitting frontal compactness, has severe limitations in performance due to the slowing down of the movement of the hot gases resulting from the back pressure caused by the abrupt turn in back of the tube. In addition the main concentration of the flame from the burner in the lower portion of the tube is on the center tube divider rather than on the wall of the tube. Heat transfer efficiency is reduced even further due to the large internal diameter of the tube, generally 4 1/2", which results in the gases moving slower than they do in a tube with less open area. A smaller tube diameter used in the same manner, while speeding up the flow of gases by having less internal area, would at the same time be ineffective since the total amount of heating surface making

contact with the water would also be reduced accordingly, and in general, even the water heaters with the 4 1/2" diameter tubes have heating surface limitations below that of water heaters using bent tubes with separate inlets and outlets.

The total travel distance of the hot gases permitted with the straight horizontal tube type construction is also considerably less than the distance of travel within a combustion chamber that utilizes separate inlet and outlet tubes, further reducing the heat transfer efficiency of such water heaters.

In a more recent patent by Bridegum a combustion chamber is employed for compact water heaters that does not utilize a tube of any kind. This combustion chamber, similar to those used in furnaces, utilizes two shell shaped halves welded together to form an internal flow pattern within a tank. While meeting the pressure requirements mandated for water heaters, this type of construction has several disadvantages inhibiting it's use. Due to the large perimeters of the two halves utilized in it's construction, a considerable amount of increased welding is required to weld the two halves together. In a typical water tank for a water heater of this type, the amount of welding required for the tank is increased by approximately 20 to 25 percent. In the case of a glass lined tank, the increase in the area of the welded surfaces inside the tank, requires that additional cathode protection in the form of a larger anode be provided, further increasing the cost of the water heater to the user. Further, to insert the front of this type of

combustion chamber into the front head of the water heater tank prior to welding, a large hole consisting of two circular holes joined together in the center with an additional narrow hole is required. This type of fabrication makes it difficult to perform automatic welding since the surfaces where the front head and combustion chamber come in contact are on different radiuses. Fit up problems between the front head and combustion chamber complicate the problem even further, since minor variances in the size of the dimensions of the welds on the portions of the combustion chamber that must protrude through the tank front head can result in either the combustion chamber not fitting through the pierced holes in the head, or a loose fit in the front head which in turn makes it impossible to weld the combustion chamber successfully into the head with automatic welding.

A need therefore exists for a water heater with a combustion chamber design that will enable the water heater to meet the smallest front dimensional requirements for small compact water heaters for recreational vehicles, permit the best possible economies by reducing the total amount of welding required, permit fully automatic welding of the combustion chamber into the front tank head, insure long tank life in the case of glass lined tanks without adding additional anode surface, and at the same time enable the water heater to obtain a higher recovery and better efficiency than water heaters of this type currently available to the recreational vehicle manufacturer and the after

market.

The present invention fulfills this need and provides further related advantages.

SUMMARY OF THE INVENTION

In accordance with the invention an improved combustion chamber is provided for compact gas fired water heaters for recreational vehicles that will permit the water heater to meet the minimum size front dimensional requirements for water heaters of this type and at the same time have an increased amount of heating surface and travel distance for the hot gases moving within the combustion chamber.

Another object of the invention is to permit the water heater to obtain higher BTU input's and larger quantities of hot water than similar water heaters available today with comparable front dimensions.

A further object of the invention is to enable the water heater to operate with greater efficiencies while at the same time allowing smaller frontal dimensions.

Still a further object of the invention is to provide an improved combustion chamber with smoother surface areas that are more suitable for glass coatings when used in conjunction with steel tanks.

Yet another object of the invention is to provide an improved design that will pass mandated hydrostatic test pressures of 300 PSI without increasing the thickness of the

material used in the fabrication..

A further object of the invention is to provide a design that will allow all welds to be performed automatically on flat surfaces minimizing the cost of the welding equipment while at the same time insuring better quality welding.

Still a further object of the invention is to reduce the total amount of welding surface, and welding time and material, required in the fabrication of a combustion chamber for use in a water heater tank with similar frontal dimensions.

The novel features which are believed to be characteristic of the invention, both as to design and method of use, together with further objects and advantages will be better understood from the following description, considered in conjunction with the accompanying drawings in which the preferred embodiments of the invention are illustrated by way of example. It is expressly understood however, that the drawings are for the purpose of illustration and description only and are not intended as a definition of the limits of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate the invention. In such drawings:

Figure 1 is a perspective cross sectional view of a small compact water heater tank with the combustion chamber utilizing the preferred embodiment for a gas fired water heater for recreational vehicles.

Figure 2 is a perspective cross sectional view of a complete small compact water heater utilizing the preferred embodiment.

Figure 3 is a top view of a die pierced flat center plate that is placed between, and welded to, the two horizontal tubes in the preferred embodiment.

Figure 3A is a top view of a die pierced flat plate for an alternative embodiment.

Figure 4, is a side cross sectional view of the coupler used in the preferred embodiment.

Figure 4A is a top view of the coupler used in the preferred embodiment.

Figure 4B is a front end view of the coupler used in the preferred embodiment.

Figure 5 is a side cross sectional view of the sub-assembly with the two horizontal tubes and the center plate that attaches to the coupler.

Figure 5A is a front end view of the assembled center plate and the two horizontal tubes.

Figure 6 is a side cross sectional view of the coupler, center plate and tube assembly.

Figure 6A is a front view of the coupler, center plate and tube assembly.

Figure 7 is a front cross sectional view of the front head of the water heater tank showing the close proximity between the upper and lower openings for welding to the tubes.

Figure 7A is a side cross sectional view of a front head

showing the flat embossed surfaces where the tubes will be welded to the head.

Figure 8 is side cross sectional view of a water heater tank utilizing the preferred embodiment, showing the combustion chamber positioned and welded in the tank.

DETAILED DESCRIPTION OF THE INVENTION

As shown in the exemplary drawing Figure 1, a water heater tank is provided that is constructed with the following basic parts: namely a front head 1, a rear head 2, a tank sheet 3, a coupling for a temperature and pressure relief valve 4, a thermostat coupling 5, a drain coupling 6, a cold water inlet coupling 7, a hot water outlet coupling 8, a combustion chamber 11, a combustion chamber inlet opening 9, and a combustion chamber outlet opening 10.

The tank shown in Figure 1, is fabricated into a small compact water heater Figure 2, with a casing 22, covering insulation that surrounds the tank 12, and a control housing 13, with a door 14, enclosing the various components in the front of the water heater. In the preferred embodiment, a burner 15, is positioned in the lower entrance of the combustion chamber 9, to receive gas from a combination thermostat/gas valve 16, through a manifold 17. Gas to the burner 15, is ignited by a pilot 18, in conjunction with a thermocouple, or in other models an electrode and spark ignition module in conjunction with a gas valve and thermostat. Once ignition

is established the water in the tank surrounding the combustion chamber is quickly heated as hot gases flow rapidly from the burner in the entrance of the combustion chamber 9, making an upward turn on the smooth radius of the coupler in the rear of the chamber 11, before exiting at the combustion chamber outlet 10. Customarily, an appropriate heat shield 19, is also located inside the control housing along with a drain 20 for winterizing the water heater, and a temperature and pressure relief valve 21. A cold water inlet 7, and a hot water outlet 8, are provided on the back of the water heater, along with a fitting for an anode not shown, if steel glass lined tanks are employed.

Importantly, the unique combustion chamber 11, provides a maximum number of square inches of heating surface, approximately 25 percent more surface than water heaters of this type currently available with similar front dimensions of 12 1/2" or less in both height and width. At the same time the area of the passageway is small enough, typically 12 percent less than a combustion chamber made with a single straight horizontal tube, to enable gases to move more rapidly and thereby increase heat transfer efficiency. The novel design of the coupler Figure 4, insures that the gases will flow smoothly around the turn in the rear of the combustion chamber further increasing efficiency, as well as recovery.

The coupler Figure 4, is formed rapidly and economically, preferably on a punch press, by a single stamping, to exact

tolerances with the radiuses on the two ends being identical to the tube radiuses being employed. Two tubes of the correct length and the same radius as the coupler ends are placed against and welded to the center plate Figure 3, from the back side. Importantly, the tubes are placed against the center plate so that only a small portion of the tubes, normally 1/4", extends beyond the plate, providing adequate clearance to perform the operation automatically with a circumferential type welder. The sub-assembly Figure 5, comprising the tubes and the center plate, is then inserted and welded into the coupler Figure 4. One skilled in the art will readily observe that this sub-assembly can be pressed into the coupler with a tight fit, where the unique design permits one final automatic weld around the oval shaped perimeter to complete the assembly. The finished assembly Figure 6 and 6A, is then attached to the front tank head by inserting the fronts of the two tubes through the pierced and embossed openings provided in the front head, Figures 7 and 7A. The flat embosses on the front head Figure 7A, permit the two final welds of the tubes to the front head, to then be welded quickly and economically with automatic circumferential type welding. The front head is then inserted and welded in the finished tank Figure 8, in the customary manner.

In an alternative embodiment Figure 3A, an oval shaped plate is die pierced with two holes to receive the two horizontal tubes. The two tubes are then inserted into the holes in the plate and welded to the plate from the back side where

adequate space is provided to also permit automatic circumferential welding. The plate is then butted against the coupler where a single automatic oval shaped weld completes the assembly automatically. The two tubes from the completed assembly are then inserted into the two holes in the front head and welded automatically just as in the preferred embodiment. Moreover the entire assembly, in either the preferred or alternative embodiment, requires considerably less welding time and less welding material than a combustion chamber made with the technology revealed in the earlier Bridegum patent employing the two shell shaped halves. Additionally the invention provides considerably more heating surface, and a subsequent increase in recovery of up to 40 percent more for a small compact water heater, than that provided by a combustion chamber employing a single horizontal tube utilizing the construction suggested in the Wariner patent, while at the same time permitting the finished water heater to maintain smaller front dimensions than a water heater utilizing the bent tube construction revealed in the Carlson or Hammersley patents.

The foregoing detailed description is illustrative of the embodiments of the invention and it is to be understood that additional embodiments will be obvious to those skilled in the art. These additional embodiments are considered to be within the scope of the invention.

WHAT IS CLAIMED IS:

1. A gas fired water heater for a recreational vehicle or other side wall mounted installations comprising a tank for receiving and storing water, an internal combustion chamber within said tank consisting of two horizontal tubes mounted in the front head of the tank, joined in the rear by a coupler so that the tubes form a "U" shaped pattern enabling hot gases from a burner to enter and exit at the front side of the tank and water heater, a means for supplying fuel and ignition to the gas burner positioned within the lower tube of the "U" shaped combustion chamber of said tank, and a means for introducing cold water into the lower portion of the tank so that hot water will exit in the upper portion of the tank to supply hot water to various hot water outlets within the recreational vehicle or other installations requiring side wall mounted gas fired water heaters.

2. The water heater as defined in Claim 1, wherein said coupler in the combustion chamber is made from a single piece of formed metal with the two end radiuses formed to receive the outside halves of tubes employing the same radiuses and a plate pierced with radiuses to match the inside halves of the tubes, subsequently welded between the two tubes, wherein the completed tube and plate assembly is then pressed and welded into said coupler.

3. The water heater defined in Claim 1, wherein said coupler in the combustion chamber is made from a single piece of formed metal with the two end radiuses formed to receive the outside halves of tubes employing the same radiuses, and a single plate larger than the front of the coupler is pierced with two holes with the same radius as the coupler end radiuses, wherein two tubes are inserted and welded into said plate, and said plate and tube assembly is then placed against and welded to the coupler with the tubes matching or fitting into the two end radiuses of the coupler.

4. The water heater as defined in Claim 2, wherein the holes on the front head for receiving the combustion chamber tubes have flat embosses to facilitate the welding of the tubes to the head.

5. The water heater as defined in Claim 3, wherein the holes on the front heads for receiving the combustion chamber tubes have flat embosses to facilitate the welding of the tubes to the front head.

Ridout & Maybee
Suite 2400
One Queen Street East
Toronto, Canada M5C 3B1
Patent Agents of the Applicant

Figure 1

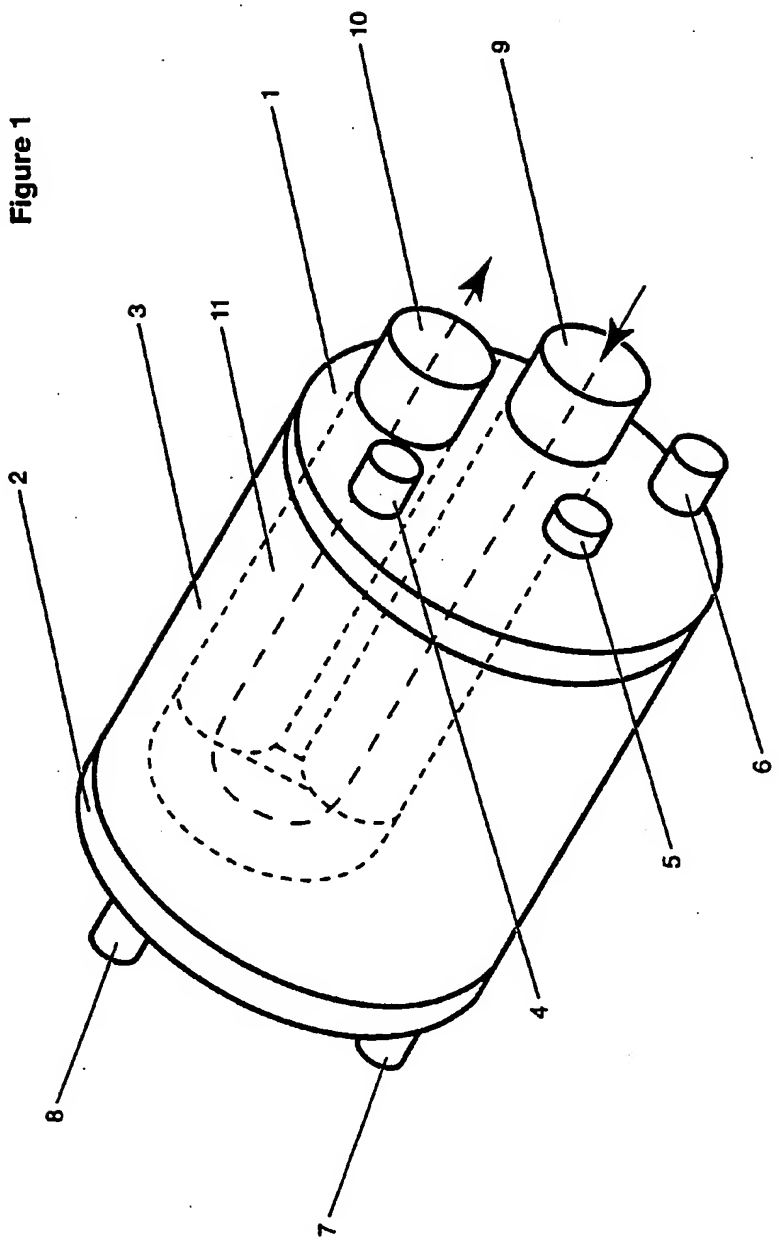
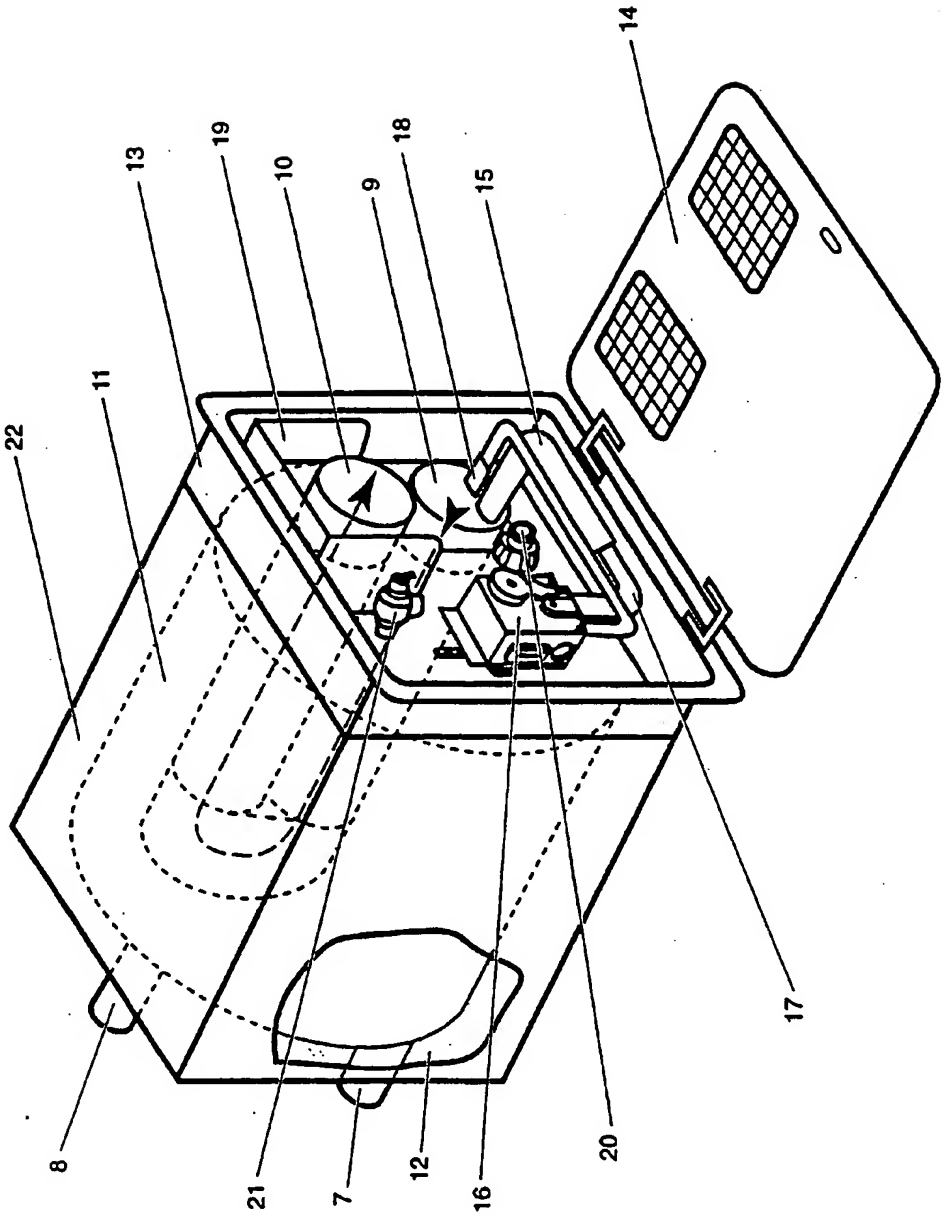


Figure 2



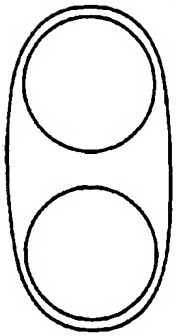


Figure 3A

Figure 3

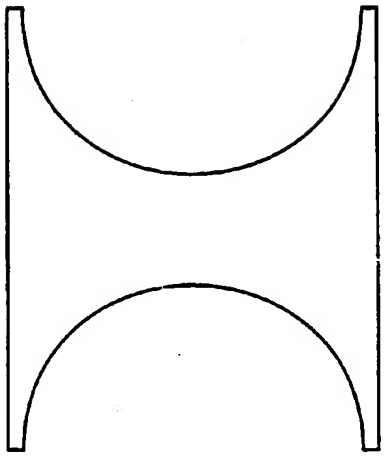


Figure 4A

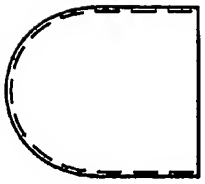


Figure 4B

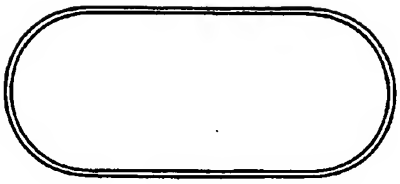
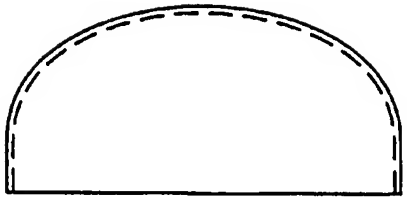


Figure 4



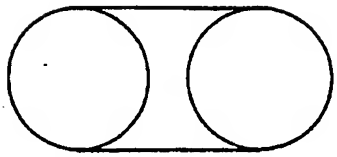


Figure 5A

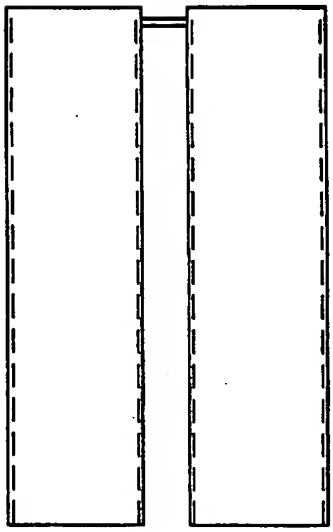


Figure 5

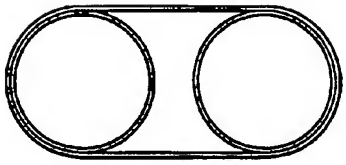


Figure 6A

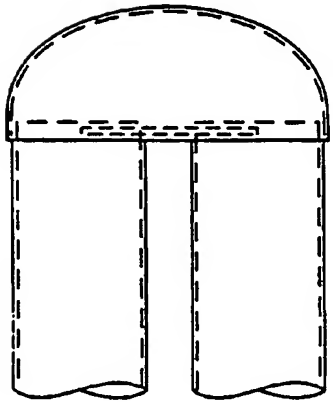


Figure 6

Figure 7A

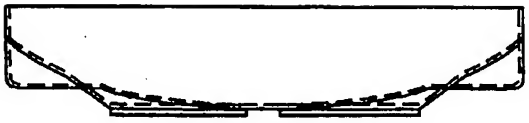
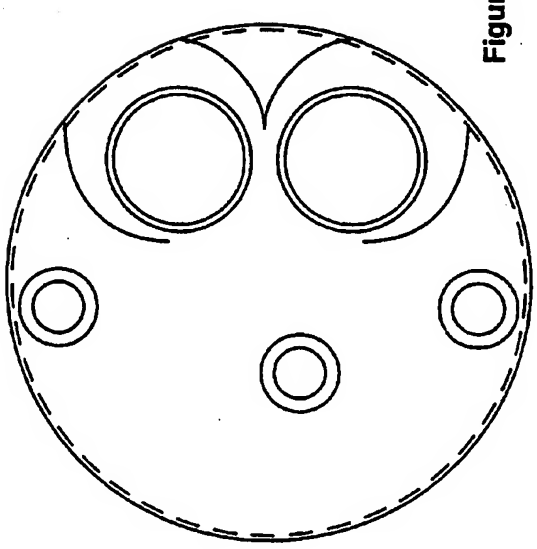


Figure 7



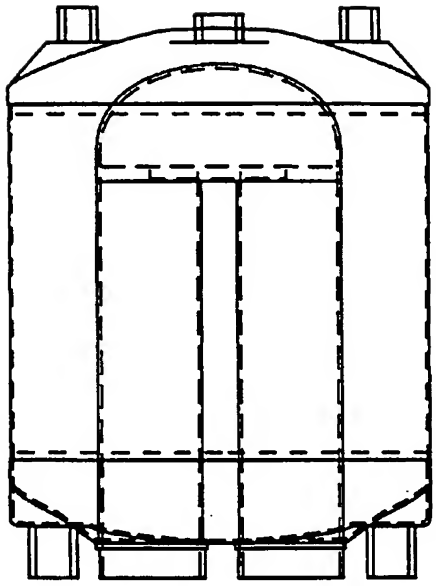


Figure 8